Key Building Blocks of Embedded IoT Designs

Luke Pao | Taiwan Country Manager | July 2016
IoT Market is Here Today

Smart Energy  Connected Home  Industrial Automation  Asset Tracking  Fitness and Health
Key Building Blocks of Embedded IoT Designs

- **SENSE**
  Products that sense the environment

- **COMPUTE**
  Products that process the data

- **CONNECT**
  Products that connect to the IoT

- **ENABLE**
  Tools that make development easy
20 Years of Innovation

A track record of multiple industry first, transforming or disrupting large markets

PC Modem
Breakthrough soft modem

Crystal Oscillators
Ultra-low jitter XOs and VCXOs

Aero Transceivers
Dominated GSM cellular market

FM/AM Tuners
1st CMOS tuner for CE & automotive

TV Tuners
Market leader since 2011

ZigBee SoCs
Mesh networking market leader

Thread Protocol
Founding member of Thread Group

Pearl/Jade Gecko
Next-gen EFM32 MCUs with HW cryptography

Wireless Modules
Bluetooth, Wi-Fi and ZigBee modules and protocol stacks

Wireless Gecko
Multiprotocol SoC portfolio for the IoT

Founded 1996
HQ Austin, Texas, USA
R&D 12 global locations
Size 1200 people
Nasdaq SLAB
Providing Building Blocks for a More Connected World

SENSE
Products that sense the environment

COMPUTE
Products that process the data

CONNECT
Products that connect to the IoT

ENABLE
Tools that make development easy
Silicon Labs Enables Wearable and IOT Sensing

Fitness Bands | Thermostats and HVAC | Wireless Sensor Nodes | Control Panels

- Heart Rate
- Blood Oxygen
- Ultraviolet
- Humidity
- Temperature
- Light
- Proximity
- Gestures
Sensors are Everywhere

2015 $5.6B SENSOR TAM

Optical $1.3B
Temp and Humidity $4.3B

Source: IHS, Markets and Markets
Relative Humidity and Temperature
RH/Temp Sensors Value Proposition

- Accurate sensing
  - ±3% RH / ±0.4°C max accuracy over a wider range than the competition
  - -40 to +125 °C temperature range

- Industry’s lowest power consumption
  - 2.2 µW @ 3.3 V, 8-bit, 1 sample/second

- Si70xx feature set provides unmatched ease of use
  - Full factory calibration and internal compensation
  - Unique, optional low-profile protective cover
  - Industry-standard footprint and software interface
  - Support for 2-zone temperature sensor (Si7013)

- Award-winning design
  - Winner of the prestigious 2014 UBM Tech / EE Times Ace Award
Si7006/13/20/21/34 RH/T Sensors with I²C Interface

- I²C interface for MCU-based applications
- Three accuracy levels for various application requirements
  - All devices support -40 to +125 °C operation
- New Si7034 available in a tiny 2x2 mm package
  - 1.8V operating voltage for lowest power consumption
- Optional cover/filter available
- Industry-standard pinouts and software interface

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Accuracy (Max)</th>
<th>Package Size</th>
<th>Vdd Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Si7034 (New!)</td>
<td>±4% RH/±0.4 °C</td>
<td>2x2 mm</td>
<td>1.62 - 1.98 V</td>
</tr>
<tr>
<td>Si7013 (w/2-zone temp sensor) Si7021</td>
<td>±3% RH/±0.4 °C</td>
<td>3x3 mm</td>
<td>1.9 - 3.6 V</td>
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<tr>
<td>Si7020</td>
<td>±4% RH/±0.4 °C</td>
<td>3x3 mm</td>
<td>1.9 - 3.6 V</td>
</tr>
<tr>
<td>Si7006</td>
<td>±5% RH/±1.0 °C</td>
<td>3x3 mm</td>
<td>1.9 - 3.6 V</td>
</tr>
</tbody>
</table>
Si700x/1x/2x RHT Sensor Advantages

- **Low power consumption**: Si70xx has the lowest power consumption in the industry.
- **Filter/cover option**: Optional filter/cover prevents damage.
- **Industry-standard pinout and software interface**: Drop-in compatible with devices from Sensirion and Measurement Specialties.
- **High Accuracy**: Wider accuracy ranges than the competition.
Optical Sensors for Proximity and Gesture
## Optical Applications

<table>
<thead>
<tr>
<th>Digital UV Sensing</th>
<th>Proximity Sensing</th>
<th>Gesture Sensing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long Battery Life - Ideal for health and fitness applications</td>
<td>Up to 2m proximity sensing, even in daylight</td>
<td>Reliable, robust gesture detection even in daylight</td>
</tr>
<tr>
<td>Simple Designs - Integrated photodiodes, ADC, and signal processing</td>
<td>Lowest power consumption for battery applications</td>
<td>Lowest power consumption for battery applications</td>
</tr>
<tr>
<td>UV values output over I2C</td>
<td>Not affected by water or gloves like cap-touch buttons</td>
<td>High dynamic range for best performance</td>
</tr>
</tbody>
</table>

Industry's First Digital UV Index Sensors for Wearable Products
Daylight Proximity and Gesture Sensing

**Si114x**

- Universally, these applications are indoors, and in dark environments
- They are generally in close proximity

**Si115x**

- No Need to be indoors
- Up to 2 meters of usable range
One person dies every hour from Melanoma. Effective UV sensing can significantly reduce this number.

- Output corresponds to actual UV scale
  - Accuracy +/- 1 ½ UV scale unit

- Low power consumption does not significantly impact batter life

- Ambient Light Sensing, used to improve the user interface, is a feature that is included in the next generation UV sensors.
HRM Solutions
HRM (Heart Rate Monitor)

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Algorithm</th>
<th>Microcontroller</th>
</tr>
</thead>
<tbody>
<tr>
<td>Si1144</td>
<td>Dynamic or Static</td>
<td>Gecko</td>
</tr>
<tr>
<td>Si1143</td>
<td>Customer Choice</td>
<td>Customer Choice</td>
</tr>
</tbody>
</table>
IC Modules for HRM

- HRM optical isolation difficult and costly with discrete
  - Gaskets make manufacturing more difficult
  - Requires separate opto-mechanical design adding cost
  - Optimizing optomechanical design commonly delays product intro

- IC module integrates Si1144 IC + LED(s) with optical isolation
  - Integrated green LED on Si1144
  - Drives up to 2 additional external LEDs
  - Integrates opto-mechanical components (blocking, lens & lid apertures)

- Low cost, minimal HW design effort
  - Place one IC Module on board with simple clear overlay
  - Optional external LEDs can be used without additional isolation
Hall Sensors
High Sensitivity Hall Sensors
Silicon Labs’ hall-effect sensors combine high performance & unique features

- Leverages Silicon Labs’ innovative mixed-signal core competency
  - Industry-leading sensitivity and lowest power consumption
  - Integrated tamper detection alerts for security and metering
  - Wide $V_{DD}$ voltage range and several options for package type and output
  - AEC-Q100 automotive qualified

- 50% to 80% smaller magnet size
- 30% to 70% larger air gap / detection range
- 10x to 15x lower power consumption
- Integrated tamper detection
Broad Portfolio of MCU and Fixed-Function Devices

- EFM8 Bee portfolio (8-bit MCUs)
  - Peripheral rich and crossbar accessible
  - Small-footprint MCUs
  - Cost-effective solutions

- EFM32 Gecko portfolio (32-bit MCUs)
  - Low-energy autonomous peripherals functional in deep sleep
  - Pin/software compatible and scalable

- Silicon Labs Xpress portfolio
  - Robust, proven fixed-function solutions
    - USB connectivity
    - Capacitive touch control
  - No firmware required
  - Simplified development, fast time to market

- USB Type C Solution
This is my EFM8

Performance
- 72 MHz
- Low power
- Fast peripherals

Value
- Small packages
- High integration
- More for less

Simplicity
- Easy migration
- Consistent tools
- Common STK

An MCU without compromise!
# EFM8 MCU Family

<table>
<thead>
<tr>
<th>Type</th>
<th>Frequency</th>
<th>Flash Memory (KB)</th>
<th>RAM Memory (KB)</th>
<th>IO (up to)</th>
<th>ADC:</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>LASER</td>
<td>Precision Analog line up to 72 MHz</td>
<td>16 - 64</td>
<td>1 - 4</td>
<td>29</td>
<td>14 bit 900 kps; 12-bit 1 Msps</td>
<td><strong>Benefits</strong></td>
</tr>
<tr>
<td><strong>Flash</strong></td>
<td><strong>72 MHz MCU in 3x3 mm² package - high integration</strong></td>
<td></td>
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<tr>
<td></td>
<td><strong>ADC/4xDAC/ 2x comparator - state-of-the-art analog</strong></td>
<td></td>
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<tr>
<td></td>
<td><strong>±3 °C temperature sensor - eliminate calibration</strong></td>
<td></td>
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<tr>
<td></td>
<td><strong>Config Logic - eliminate external glue logic</strong></td>
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<tr>
<td></td>
<td><strong>USB up to 48 MHz</strong></td>
<td>8 - 64</td>
<td>2 - 4</td>
<td>40</td>
<td>12-bit 200 kps; 10 bit 800 kps</td>
<td><strong>Benefits</strong></td>
</tr>
<tr>
<td></td>
<td><strong>No external crystal or regulator - save</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Low Energy USB mode - save battery</strong></td>
<td></td>
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<tr>
<td></td>
<td><strong>Integrated USB Charger Detect (USB - BCS v1.2) - increased functionality for customer</strong></td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td><strong>Low Power up to 25 MHz</strong></td>
<td>2 - 64</td>
<td>0.5 - 4</td>
<td>24</td>
<td>12 bit 75 kps; 10-bit 300 kps</td>
<td><strong>Benefits</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Energy friendly - 50 nA sleep mode</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td><strong>Active currents - 150 uA/MHz</strong></td>
<td></td>
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<tr>
<td></td>
<td><strong>Fast wake up - &lt; 2 us</strong></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td><strong>Capacitive sense - &lt;1µA wake on touch</strong></td>
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<tr>
<td>BUSY</td>
<td><strong>Value line up to 50 MHz</strong></td>
<td>2 - 64</td>
<td>0.5 - 2</td>
<td>29</td>
<td>12 bit 350 kps; 10-bit 1.125 Msps</td>
<td><strong>Benefits</strong></td>
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<tr>
<td></td>
<td><strong>High-Clock Speeds - Do more with MCU</strong></td>
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<tr>
<td></td>
<td><strong>High-integration - lower cost for customer</strong></td>
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<tr>
<td></td>
<td><strong>Priority crossbar - simplify PCB design</strong></td>
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<td></td>
<td><strong>Industrial grade available</strong></td>
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<tr>
<td>SLEEPY</td>
<td><strong>Low Power up to 25 MHz</strong></td>
<td>2 - 64</td>
<td>0.5 - 4</td>
<td>24</td>
<td>12 bit 75 kps; 10-bit 300 kps</td>
<td><strong>Benefits</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Energy friendly - 50 nA sleep mode</strong></td>
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<td><strong>Capacitive sense - &lt;1µA wake on touch</strong></td>
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<tr>
<td>UNIVERSAL</td>
<td><strong>USB up to 48 MHz</strong></td>
<td>8 - 64</td>
<td>2 - 4</td>
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<td>12-bit 200 kps; 10 bit 800 kps</td>
<td><strong>Benefits</strong></td>
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<td><strong>No external crystal or regulator - save</strong></td>
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<td><strong>Low Energy USB mode - save battery</strong></td>
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<td></td>
<td><strong>Integrated USB Charger Detect (USB - BCS v1.2) - increased functionality for customer</strong></td>
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</table>

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25
EFM32 - a Truly Unique Microcontroller

CPU and Memory
- ARM Cortex-M processor
  - Flash Program Memory
  - RAM Memory
  - Debug Interface
  - DMA

Clock Management
- Memory Protection Unit
- Embedded Trace Macrocell
- Low Freq Crystal Osc
- High Freq Crystal Osc
- Ultra Low Freq RC Osc
- Low Freq RC Osc
- Auxiliary RC Osc

Energy Management
- Voltage Regulator
- Brown-out Detector
- Back-up Power Domain
- Power-on Reset

Peripheral Reflex System
- 32-bit bus

Serial Interfaces
- USART
- UART
- Low Energy UART
- USB

I/O Ports
- External Bus Interface
- General Purpose I/O
- Pin Reset
- TFT Driver

Timers and Triggers
- Timer/Counter
- Low Energy Timer
- Pulse Counter
- Backup RTC
- Real Time Counter
- Watchdog Timer

Analog Modules
- ADC
- DAC
- Analog Comparator

Security
- AES Accelerator

Available Down To:
- EM0 (Run Mode)
- EM1 (Sleep)
- EM2 (Deep Sleep)
- EM3 (Stop Mode)
- EM4 (Shutoff Mode)
## EFM32 Portfolio

### Software compatible

<table>
<thead>
<tr>
<th>M4 w/FPU</th>
<th>Optional Features</th>
<th>Pin compatible within each package</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wonder</td>
<td>USB</td>
<td>EFM32WG940, EFM32WG942, EFM32WG980, EFM32WG990, EFM32WG995</td>
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<tr>
<td></td>
<td>LCD</td>
<td>EFM32WG330, EFM32WG332, EFM32WG380, EFM32WG382, EFM32WG386</td>
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<td>TFT</td>
<td>EFM32WG840, EFM32WG842, EFM32WG880, EFM32WG882, EFM32WG886</td>
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<td></td>
<td></td>
<td>EFM32WG230, EFM32WG232, EFM32WG280, EFM32WG282, EFM32WG286</td>
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<tr>
<td>Giant</td>
<td>USB</td>
<td>EFM32LG940, EFM32LG942, EFM32LG980, EFM32LG990, EFM32LG995</td>
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<tr>
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<td>LCD</td>
<td>EFM32LG330, EFM32LG332, EFM32LG380, EFM32LG382, EFM32LG386</td>
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<td>TFT</td>
<td>EFM32LG840, EFM32LG842, EFM32LG880, EFM32LG882, EFM32LG886</td>
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<tr>
<td>Leopard</td>
<td>USB</td>
<td>EFM32GL940, EFM32GL942, EFM32GL980, EFM32GL990, EFM32GL995</td>
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<td>EFM32GL330, EFM32GL332, EFM32GL380, EFM32GL382, EFM32GL386</td>
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<td>EFM32GL840, EFM32GL842, EFM32GL880, EFM32GL882, EFM32GL886</td>
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<td>EFM32GL230, EFM32GL232, EFM32GL280, EFM32GL282, EFM32GL286</td>
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<td>M3</td>
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<td>EFM32G210, EFM32G230, EFM32G280</td>
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<td>EFM32G240, EFM32G242, EFM32G282</td>
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<td>EFM32G222, EFM32G224, EFM32G284</td>
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<tr>
<td>Tiny</td>
<td>LCD</td>
<td>EFM32TG210, EFM32TG230, EFM32TG280</td>
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<tr>
<td>GeckO</td>
<td>LCD</td>
<td>EFM32TG240, EFM32TG242, EFM32TG282</td>
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<td>EFM32TG222, EFM32TG224, EFM32TG284</td>
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<tr>
<td>Happy</td>
<td>USB</td>
<td>EFM32HG330, EFM32HG332, EFM32HG380</td>
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<td>EFM32HG382, EFM32HG384, EFM32HG386</td>
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<td>EFM32HG232, EFM32HG234, EFM32HG284</td>
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<td>QFN24</td>
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<td>QFN64</td>
<td>EFM32G222, EFM32G224, EFM32G284</td>
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<td>QFP48</td>
<td>EFM32G210, EFM32G230, EFM32G280</td>
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<td>QFP64</td>
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<td>QFP100</td>
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<td>BGA48</td>
<td>EFM32G210, EFM32G230, EFM32G280</td>
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<td>BGA112</td>
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<td></td>
<td>BGA120</td>
<td>EFM32G222, EFM32G224, EFM32G284</td>
</tr>
</tbody>
</table>

- **WLCSP package**: Wonder, Leopard and Happy Gecko are available in an ultra-small CSP81/CSP36 package - EFM32WG360, EFM32LG360 and EFM32HG350
- **Wafer sales**: Giant, Wonder, Leopard, and Gecko are available in wafer form - EFM32GG900, EFM32WG900, EFM32LG900, and EFM32GG800.
EFM32 Zero Gecko

Max frequency: 24 MHz
4 - 32 kB Flash
2 - 4 kB RAM

Package Options
QFN24 (5x5 mm)
QFN32 (6x6 mm)
QFP48 (7x7 mm)
EFM32 Happy Gecko

Max frequency: 25 MHz
32 - 64 kB Flash
4 - 8 kB RAM

Package Options
CSP36 (3x3 mm)
QFN24 (5x5 mm)
QFN32 (6x6 mm)
QFP48 (7x7 mm)
Max frequency: 32 MHz
4 - 32 kB Flash
2 - 4 kB RAM

Package Options
BGA48 (4x4 mm)
QFN24 (5x5 mm)
QFN32 (6x6 mm)
QFN64 (9x9 mm)
QFP48 (7x7 mm)
QFP64 (10x10 mm)
EFM32 Gecko

Peripheral Reflex System

CPU and Memory
- ARM Cortex-M3 processor
- Flash Program Memory
- RAM Memory
- Debug Interface
- DMA
- Memory Protection Unit
- Debug Trace

Clock Management
- High Freq Crystal Osc
- High Freq RC Osc
- Low Freq Crystal Osc
- Low Freq RC Osc
- Ultra Low Freq RC Osc
- Auxiliary RC Osc
- Real Time Counter
- Watchdog Timer
- Low Energy Sensor IF
- Low Energy Timer
- Timer/Counter
- Pulse Counter
- Pin Reset
- Backup RTC
- General Purpose I/O
- TFT Driver
- USB
- I2C
- UART
- USART
- DMA

Energy Management
- Voltage Regulator
- Voltage Comparator
- Brown-out Detector
- Power-on Reset
- Back-up Power Domain
- Operational Amplifier
- Analog Comparator
- Analog Controller
- IDE
- ADC
- DAC
- LCD Controller
- AES Accelerator

Max frequency: 32 MHz
16 - 128 kB Flash
8 - 16 kB RAM

Package Options
- QFN32 (6x6 mm)
- QFN64 (9x9 mm)
- QFP48 (7x7 mm)
- QFP64 (10x10 mm)
- QFP100 (14x14 mm)
- BGA112 (10x10 mm)
- Wafer Sales
EFM32 Leopard Gecko

Max frequency: 48 MHz
64 - 256 kB Flash
32 kB RAM

Package Options
QFN64 (9x9 mm)
QFP64 (10x10 mm)
QFP100 (14x14 mm)
BGA112 (10x10 mm)
BGA120 (7x7 mm)
CSP81 (4.3x4.4 mm)
Wafer Sales
EFM32 Giant Gecko

Max frequency: 48 MHz
512 - 1024 kB Flash
128 kB RAM

Package Options
QFN64 (9x9 mm)
QFP64 (10x10 mm)
QFP100 (14x14 mm)
BGA112 (10x10 mm)
BGA120 (7x7 mm)
Wafer Sales
EFM32 Wonder Gecko

Max frequency: 48 MHz
64 - 256 kB Flash
32 kB RAM

Package Options
QFN64 (9x9 mm)
QFP64 (10x10 mm)
QFP100 (14x14 mm)
BGA112 (10x10 mm)
BGA120 (7x7 mm)
CSP81 (4.3x4.4 mm)
Wafer Sales
**EFM32 Pearl & Jade Gecko**

- **Processor and memory**
  - Cortex-M4 with FPU or Cortex-M3
  - Up to 40 MHz
  - 128-256 kB Flash, 32 kB RAM
    - 512-1024 kB Flash, 256 kB RAM - samples 4Q16

- **Power**
  - 63 μA/MHz
  - 1.4 μA deep sleep with retention/BOD/RTCC
  - 1.85–3.8 V single power supply

- **Packages**
  - QFN32 (5 mm x 5 mm)
  - QFN48 (7 mm x 7 mm)
Introducing the TouchXpress Family

- No firmware development needed
- No capacitive sense expertise needed
- No external components required

Easy firmware and hardware

- Simple configuration utility
- Capacitive Sense Profiler
- Factory programming options

Low power and robust

- Active current - 200 µA
- Sleep current - 1 µA
- Robust solution: SNR > 200:1

Easy configuration and reduced risk

- No firmware development needed
- No capacitive sense expertise needed
- No external components required
Get Started Today!

- Choose the TouchXpress device that is right for your application
- Select an Evaluation Kit
- Open Simplicity Studio and start development

<table>
<thead>
<tr>
<th>Product Matrix</th>
<th># ch</th>
<th>Interface</th>
<th>Slider</th>
<th>Wake-on prox</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPT007B</td>
<td>7</td>
<td>GPIO</td>
<td>No</td>
<td>Yes</td>
<td>QFN20</td>
</tr>
<tr>
<td>CPT112S</td>
<td>12</td>
<td>I2C</td>
<td>Yes</td>
<td>Yes</td>
<td>QFN20</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Kit Matrix</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLEXP8007A</td>
<td>CPT007B Capacitive Sense Evaluation Board</td>
</tr>
<tr>
<td>SLEXP8008A</td>
<td>CPT112S Capacitive Sense Evaluation Board</td>
</tr>
</tbody>
</table>
USB Type-C Video Adapter Dongle Functions

- **Power Delivery (PD) Controller**
  - Type-C attach/detach detection
  - Power contract negotiation
  - Alternate mode detection and selection
  - Uses Silicon Labs EFM8 MCU and stack API for PD control

*If alternate mode entry fails....*

- **Billboard Device**
  - Communicates failure of alternate mode entry to the host via USB
  - Pop-up message window to the user
  - Uses cost-effective Silicon Labs EFM8 MCU
Start Your USB Type-C Connector Designs Today

- PD and Billboard Devices available today
- Dongle reference design
  - Full release available now
- Dongle + Charger reference design
  - Full-feature release in Q4 2016
- Complete software solution available free of charge
  - Schematics and Gerber files
  - PD protocol stack library
  - Billboard device code
  - Sample code for USB-C to DP
  - Simplicity Studio development tools
Providing Building Blocks for a More Connected World

SENSE
Products that sense the environment

COMPUTE
Products that process the data

CONNECT
Products that connect to the IoT

ENABLE
Tools that make development easy
IoT Wireless Connectivity
Wireless Solutions - Hardware

**Proprietary**
- Sub GHz Transceivers: EZRadio and EZRadioPRO Sub GHz Solutions
- Sub GHz Wireless MCU:
  - 8-bit WMCU (Si106x, Si108x, Si4010 ..)
  - 32-bit WMCU: EZR32, EFR32 (Flex Gecko)
- 2.4 GHz Wireless MCU:
  - 32-bit WMCU: EFR32 (Flex Gecko)

**ZigBee / Thread**
- WMCU: EM3xxx, EFR32 Mighty Gecko, **Modules: Telegesis Mesh modules**

**Bluetooth**
- WMCU: EFR32 Blue Gecko (EFR32 Mighty Gecko), **Modules: BGM111, BGM113...**

**WiFi**
- **Modules: WGM110...**
## ETRX3 Family of Modules

<table>
<thead>
<tr>
<th>Module</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ETRX357</td>
<td>Integrated antenna</td>
</tr>
<tr>
<td>ETRX357HR</td>
<td>Antenna connector</td>
</tr>
<tr>
<td>ETRX357-LRS</td>
<td>Long Range, PA/LNA, Integrated antenna</td>
</tr>
<tr>
<td>ETRX357HR-LRS</td>
<td>Long Range, PA/LNA, Antenna connector</td>
</tr>
<tr>
<td>ETRX3587</td>
<td>Integrated antenna, extra Memory</td>
</tr>
<tr>
<td>ETRX3587HR</td>
<td>Antenna connector, extra Memory</td>
</tr>
<tr>
<td>ETRX3587-LRS</td>
<td>Long Range, PA/LNA, extra Memory</td>
</tr>
<tr>
<td>ETRX3587HR-LRS</td>
<td>Long Range, PA/LNA, Antenna connector, extra Memory</td>
</tr>
</tbody>
</table>
Blue Gecko

WT12, WT11i, WT41, WT32i

BT111
BT121

BGM111
BGM113

Blue Gecko is Bluetooth® Smart
Drop-In & Connect with a Fully Integrated, Pre-Certified Solution

- **BGM113 best-in-class size** (9.2 mm x 15.8 mm)
- **BGM111 exceptional RF performance for long range**
- **Rapid time-to-market with onboard stack, antenna, certifications**
- **Reliable, secure and flexible protocol stack**
- **Powerful tools; Simplicity Studio, Energy Monitor BGScript™ or CSDK allows for standalone operation**
- **Worldwide application engineering support**
- **Footprint compatible with Mighty Gecko mesh modules**
### BGM111 and BGM113 Module Details

<table>
<thead>
<tr>
<th></th>
<th>BGM111</th>
<th>BGM113</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions</td>
<td>12.9 x 15.0 x 2.2 mm</td>
<td>9.2 x 15.8 x 1.83 mm</td>
</tr>
<tr>
<td>EIRP, TX</td>
<td>+8 dBm</td>
<td>+3 dBm</td>
</tr>
<tr>
<td>Receiver sensitivity:</td>
<td>-94 dBm</td>
<td>-94 dBm</td>
</tr>
<tr>
<td>Link Budget</td>
<td>102 dB</td>
<td>98 dB</td>
</tr>
<tr>
<td>Low Power, 0 dBm</td>
<td>8.8 mA TX Peak</td>
<td>8.8 mA TX Peak</td>
</tr>
<tr>
<td>Sleep, timer active</td>
<td>0.6 μA, EM4H with Cryotimer</td>
<td>0.6 μA, EM4H with Cryotimer</td>
</tr>
<tr>
<td>Qualified</td>
<td>Bluetooth, CE, FCC, IC, Korea, JP</td>
<td>Bluetooth, CE, FCC, IC, Korea, JP</td>
</tr>
</tbody>
</table>

#### Integrated Bluetooth Smart and MCU
- ARM Cortex™ M4 with FPU up to 40 MHz
- 256 kB flash memory / 32 kB RAM memory
- Integrated high-efficiency chip antenna
- UART, SPI, I2C, PWM, GPIO 12-bit ADC and DAC
- Crypto accelerator, 32-bit RTCC, Watchdog timer

#### Integrated Bluetooth® Smart Software
- Bluetooth 4.1 / 4.2
- Central and peripheral modes
- L2CAP, ATT, GAP, SM and GATT
- Any GATT based Bluetooth Smart profile
Introducing Wizard Gecko WGM110 Wi-Fi® Module

- Best-in-class size with exceptional RF performance for long range
- Rapid time-to-market with onboard stack, antenna, certifications
- Reliable, secure and flexible protocol stack
- BGScript™ allows for standalone operation
- Worldwide application engineering support

Rapid Time to Market

Small Size & Exceptional RF

Free Tools & Support

Co-processor & Standalone modes
WGM110 Module Details

Integrated Wi-Fi® radio and energy friendly MCU
- EFM32 ARM Cortex™ M3 at 48 MHz
- 1 MB flash memory / 128 kB RAM memory
- IEEE 802.11 b/g/n radio, 2.4GHz frequency band
- Integrated high-efficiency chip antenna
- 0.12mA Sleep, unassociated
- 1.1mA Associated, idle (DTIM=3, 100 ms beacon period)
- 261mA Continuous transmit (+16 dBm, 1 Mbps)
- 81mA Continuous receive (1 Mbps or 54 Mbps)

Radio Performance and Features
- Transmit power : +16 dBm
- Receiver sensitivity: -98 dBm
- Typical range: 300m~500m
- Client mode or Access Point mode with up to five clients
- WPA/WPA2 Enterprise and Personal, WEP encryption
- Wi-Fi Protected Setup (WPS)

Integrated Wi-Fi® Software
- Embedded Bluegiga Wi-Fi stack
- TCP, UDP, SSL/TLS, WPA2 Enterprise/Personal
- Built-in HTTP server
- DHCP and DNS client and server
- mDNS client
- BGAPI host protocol (NCP Mode)
- BGScript programming for standalone applications
- Field upgradable via DFU

Temperature range: -40°C to +85°C
- Dimensions: 14.4 x 21.0 x 2.0mm

CE, FCC, IC, South-Korea and Japan qualified

20-40% Smaller size than competition

Interfaces
- Host: UART, SPI, USB
- Peripherals; UART, SPI, I2C and USB, PWM, GPIO, ADC, RTC, SD Card
## Wireless Gecko Portfolio Overview

<table>
<thead>
<tr>
<th></th>
<th>✓</th>
<th>✓</th>
<th>✓</th>
<th>✓</th>
<th>✓</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mighty Gecko</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flash</td>
<td>256 kB</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DC</td>
<td>Up to 19.5 dBm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency</td>
<td>&lt;1 GHz + 2.4 GHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Package</td>
<td>QFN32, QFN48, WLCSP40</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Blue Gecko</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Flash</td>
<td>128-256 kB</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DC</td>
<td>Up to 19.5 dBm</td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Flex Gecko</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Flash</td>
<td>32-256 kB</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>DC</td>
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<td>Frequency</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Package</td>
<td>QFN32, QFN48</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Many Multi-protocol Use Cases

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Use Case</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single</td>
<td>Single protocol</td>
<td>No ability to change, ever</td>
<td>Standard way of operating</td>
</tr>
<tr>
<td>Programmable</td>
<td>One-time decision</td>
<td>Production-line decision</td>
<td>Choose the protocol for a ceiling fan on the production line based on demand</td>
</tr>
<tr>
<td>Switched</td>
<td>Bootload to change protocols</td>
<td>BLE Commissioning of ZigBee device</td>
<td>Commission a door lock with a smart phone</td>
</tr>
<tr>
<td>Dynamic</td>
<td>Time slice between networks</td>
<td>Primary Thread Network, periodically transmit BLE beacon</td>
<td>Lighting fixture in retail lighting application</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Primary ZigBee Network, switch to BLE if an eligible device is present</td>
<td>Hospital bed primarily on ZigBee network switches to BLE when nurse wants control</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Listen on one network, transmit on another for network translation</td>
<td>Garage door opener listens for BLE command from smart phone, transmits proprietary protocol</td>
</tr>
<tr>
<td>Concurrent</td>
<td>Actively participates on 2 networks</td>
<td>One chip living on Thread and ZigBee networks</td>
<td>Network coordinator in a home gateway</td>
</tr>
</tbody>
</table>
“Energy Friendly” - More Than Just “Low Power”

- Low active / sleep current consumption
  - 63 μA/MHz, 8.8 mA TX
  - 1.4 μA, 2 μA wakeup
- Keeping MCU core off as long as possible
  - Peripheral Reflex System (PRS)
- Energy-efficient peripherals
  - Low-Energy Sensor Interface (LESENSE)
  - Low-Energy UART (LEUART)
  - Cryotimer
- DC-DC converter powers chip and system
  - External output from DC-DC
- Hardware and software co-development
  - Optimizes operation of wireless stacks
Integration and Scalability

- Integrated +19.5 dBm power amplifier
- Integrated 2.4 GHz balun
- Hardware crypto reduces power
- Memory options from 32 kB to 256 kB
- 5V tolerant I/O for legacy designs
- Peripheral mix provides robust features
- Package options provide flexibility
  - QFN32
  - QFN48
  - WLCSP (future)
Easy-to-Use Wireless Starter Kits

- Integrated J-Link debugger
  - Connect via USB or Ethernet
  - Virtual Com Port support
- Packet Trace
- Energy Profiler
- Easy-to-use Wireless Starter Kits
  - USB power or battery power
  - Ultra-low-power 128x128 pixel memory LCD, buttons and LEDs
  - ARM Coresight 19-pin debug/trace header
  - Expansion header for prototyping
  - Radio card header for easy swapping
  - Radio pin access headers for prototyping
  - Advanced Energy Monitoring (AEM)
  - USB Serial Port
  - Packet Trace Port
  - Radio card header for easy swapping
  - Expansion header for prototyping
  - ARM Coresight 19-pin debug/trace header
  - Radio pin access headers for prototyping
Getting Started with Wireless Gecko

- **Choose the SoC that fits your needs**

<table>
<thead>
<tr>
<th>Family</th>
<th>Protocols</th>
<th>Band</th>
<th>Max TX Output Power</th>
<th>100K SoC Price (USD)</th>
<th>Development Kit</th>
<th>MSRP (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mighty</td>
<td></td>
<td>2.4 GHz</td>
<td>+19.5 dBm</td>
<td>$2.11</td>
<td>3 Node Mesh Networking Kit</td>
<td>$499</td>
</tr>
<tr>
<td>Flex</td>
<td>Proprietary</td>
<td>2.4 GHz</td>
<td>+19.5 dBm</td>
<td>$2.06</td>
<td>2 Node Proprietary Network Kit</td>
<td>$229</td>
</tr>
<tr>
<td>Blue</td>
<td></td>
<td>2.4 GHz</td>
<td>+19.5 dBm</td>
<td>$0.99</td>
<td>Single Node Bluetooth Smart Kit</td>
<td>$99</td>
</tr>
</tbody>
</table>

- **Experience the benefits**
  - Integration of robust MCU and high-performance radio
  - Low active power consumption and sleep currents
  - Supports ZigBee, Thread, BLE and proprietary networks
Providing Building Blocks for a More Connected World

**SENSE**
Products that sense the environment

**COMPUTE**
Products that process the data

**CONNECT**
Products that connect to the IoT

**ENABLE**
Tools that make development easy
Simplicity Studio

- Automatic code creation, debug, and power profile tools
- Updated tools, software and documentation at your finger tips
Simplify RF Design with Simplicity Studio™

- **Hardware Configurator**
  - Graphical configuration
  - Error checking & calculators

- **Application Builder**
  - High-level APIs
  - Stack configuration

- **IDE**
  - Eclipse framework
  - Build tools: Keil®, IAR®, GCC
  - Third-party IDEs also supported

- **Documentation** - one stop shop
Prototype and Develop

- **Energy Profiler**
  - Real-time energy consumption analysis
- **Network Analyzer**
  - Packet trace for advanced debug
- **Certified Networking Stacks**
- **Third-Party Application Layers**
  - AllJoyn, HomeKit, ZigBee Cluster Library, Bluetooth SiG
- **RAIL**
  - Customizable radio / packet parameters
- **EMLIB and EMDRV**
  - Common peripheral drivers across families
Silicon Labs: Leading Provider for IoT Building Blocks

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Thank You!

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